Developing Air Toxic Emission Inventories for Mobile Sources

Rich Cook
U.S. EPA, Office of Transportation and Air Quality

Air Toxics Risk Assessment Modeling Tools Symposium
Region 5, July 15-17, 2003

List of Hazardous Air Pollutants (HAPs) emitted by mobile sources

- Acetaldehyde
- Acrolein
- Arsenic Compounds
- Benzene*
- 1,3-Butadiene
- Chromium Compounds
- Dioxins/Furans
- 2,2,4-Trimethylpentane
- Diesel PM + OG
- Ethylbenzene*
- Formaldehyde
- n-Hexane*
- Lead Compounds
- Manganese Compounds
- Mercury Compounds
- MTBE*
- Naphthalene*
- Nickel Compounds
- POM
- Styrene
- Toluene*
- *Xylenes

*Found in evaporative as well as exhaust emissions.

Emission Inventory Development -- Highway Sources

- Emission factors x VMT
- MOBILE6.2 used to develop emission factors
  - Per mile emissions for motor vehicle HAPs
  - Also used for HC,CO, NOx, PM
  - www.epa.gov/otaq/m6.htm
- Input Data
  - Speeds, fleet mix, % cold starts, I/M Program, fuel parameters

Emission Inventory Development -- Highway Sources

- MOBILE6.2 used to develop inventory estimates for 35 pollutants in NEI
  - calculation of emission factors for several HAPs fully integrated into MOBILE6 framework
    - benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, MTBE
    - modeling process much more simplified than for previous highway vehicle HAP model, MOBTOX5b
  - emissions of other HAPs estimated based on user provided information

Emission Inventory Development -- Highway Sources

- Benzene, 1,3-butadiene, formaldehyde, acetaldehyde, acrolein, MTBE explicitly modeled in MOBILE6.2
  - benzene and MTBE: component of evaporative and exhaust emissions
  - air toxic/VOC ratio multiplied by MOBILE6.2 VOC
    - vary by technology group, vehicle type, normal versus high emitter, fuel characteristics

Emission Inventory Development -- Highway Sources

- Other pollutants modeled using "ADDITIONAL HAPs" command
  - User provided inputs:
    - ratios of toxics to TOG or VOC (gaseous HAPs)
    - ratios of toxics to PM (PAHs)
    - basic emission rates (metals)

Emission Inventory Development -- Highway Sources

- VMT
  - Decision of data source dependent on scale and resolution needs
    - NATA and other regional modeling use county-level VMT
      - From DOT's HPMS reports
      - More accurate at State or Regional level
      - VMT assigned to smaller areas using surrogates
    - Better to use a city's own link-level VMT data for local scale assessments
      - Traffic counts
      - Travel demand model
      - VMT more accurately located

How to Refine Highway Emission Inventory

- Use local speeds
  - 1996 NATA used only one average speed
- Use local inputs where available
  - Regional scale analysis often uses national defaults for:
    - Fleet mix
    - % cold start

Highway Emission Inventory: Information Sources

- 1999 National Emissions Inventory
  - www.epa.gov/ttn/chief/nti
- Sources of local VMT, speed, other inputs
  - EPA Regions
    - Mobile source, transportation, SIP experts
  - Metropolitan Planning Organizations (MPOs)
    - Local trans. agency for areas w/ pop > 50,000
  - State Air Quality Agency
    - For areas with SIPs or maintenance plans
  - State Department of Transportation

Emission Inventory Development -- Nonroad Sources

- Equipment in NONROAD Model
  - Criteria pollutant inventories
    - http://www.epa.gov/otaq/nonrdmdl.htm
  - Can apply speciation data to develop HAP inventories
  - Inventory in 1999 NEI
- Commercial marine, locomotives, aircraft not in model
    - Estimates developed for NEI

Emission Inventory Development -- Nonroad Sources

- Nonroad spatial allocation
  - Nationwide emissions allocated using national activity surrogates (e.g. construction dollars for construction equipment)
  - There may be better data at local scale
  - Improvement needed
    - Identified as need in SAB review of National Air Toxics Assessment

Mobile Source HAP Emissions
Draft NEI for HAPs, version 3

Pollutant	*Onroad*	*Nonroad*
Benzene	175,000	65,000
1,3-Butadiene	24,000	8,000
Formaldehyde	80,000	43,000
Acetaldehyde	29,000	18,000
Acrolein	4,000	2,000

Limitations and Uncertainties in Mobile Source HAP Inventories

- Highway Vehicles
  - Toxic to VOC ratios for heavy duty vehicles from only a few tests
  - Impacts of fuel formulation not addressed in diesels
  - Off-cycle effects based on limited data
  - Toxic to VOC ratios assumed to be constant in all modes of vehicle operation

Limitations and Uncertainties in Mobile Source HAP Inventories

- Nonroad Sources
  - Uncertainty in county level allocation in NONROAD
  - Uncertainty in sub-county allocations in emission pre-processors
  - Limited speciation data
    - tests on several engines for some categories
    - no test data for most categories
      - similar engine types used as surrogates
  - Little data on fuel impacts

Tools of the Future

- National Mobile Inventory Model (NMIM)
  - Consolidates MOBILE and NONROAD into one modeling system
    - includes HAPs for highway and nonroad
  - Generates county level inventories
  - Outputs suitable for emission pre-processors
  - Development nearing completion; release date undetermined

Tools of the Future

- MOVES
  - will have multi-scale modeling capability
  - full life-cycle emissions (including well to pump)
  - Completion planned for 2005/2006 timeframe
  - More information at www.epa.gov\otaq\ngm.htm